LIFE AND ITS BEGINNINGS

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QUESTIONS OF SEX

Life and Its Beginnings

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BY

Helen Webb, M.B. (Lond.)

"To create a little flower is the labour of ages."
—William Blake

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PREFACE

BY BISHOP BOYD CARPENTER

THE Rev. Dr. Meyer has written a kind and sympathetic general introduction to these books on the difficult and delicate question of sex. No one can doubt the importance of the subject, and most people will agree with Dr. Meyer in his contention that right guidance in early years is more likely to be of service than repressive measures afterwards.

Knowledge, wisely imparted, may protect innocence ; while knowledge withheld may provoke contaminating curiosity. The authors of the books for which Dr. Meyer's general introduction has been written are responsible severally for the views advanced, but, whatever differences of opinion may exist on this question, all will recognise the spirit of conscientious courage which pervades the books and the general introduction alike.

W Boyd Carpenter

President of the National Council of Public Morals.

GENERAL INTRODUCTION

BY F. B. MEYER, B.A.

GENERATION after generation, as from a fountain, the fresh and crystal streams of new young life are rising from the depths of Being, and pouring over the world. If only we, whose experience has made us sadly wise, could preserve these streams from being fouled, we should deserve and win the thanks of coming time. The prisons and reformatories, the vast apparatus of repressive and counteractive agencies, on which we now expend our resources, would be reduced to a minimum, and the light of a happier age would gild the mountain summits and steal down to the valleys of the world.

They say that this is a vain dream, that the poison enters the springs at too low a depth for us to reach, and that the force of inherited tendency is too subtle and pervasive for us to neutralise. But even if that be partially true, surely our critics must confess that we who are directing our energies towards the young life of the age are more likely to accomplish lasting results than those who deal with the poisoned streams when in their full strength.

There is no peril more insidious and fatal than that which "walketh in the darkness" of ignorance concerning sex. The policy of evading, with silly and misleading answers, the natural curiosity of young people about their origin has been tried for generations with disastrous results. What has been the result of this policy of silence about the primal facts of life? What are the fruits that have resulted from the reticence of parents, teachers, and others? The vast accumulation of quackery, of bad literature, of dishonoured lives, wrecked homes, and untimely graves, must answer! On the other hand, we have yet to learn of instances where the tactful presentation of the facts and laws of race-continuance, as given by pure and wise lips, has resulted in evil.

These considerations have led to the publication of this series of books on

Questions of Sex. It will be noticed, first, that they are carefully graded; secondly, that they are written by experts in a plain and wholesome manner; thirdly, if they err at all, it is on the side of saying too little. But that is a wholesome defect, and it can always be left to the wise parent or teacher to add whatever else may seem desirable.

These books form a series, and are complementary. It is very desirable that this should be borne in mind, and that they should be viewed as the successive steps by which young boys or girls may be led forward respectively. Other books will be issued subsequently to take the young people still further.

The allusions to plant life and to

the lower forms of animal life are not only extremely fascinating, but in a perfectly chaste and simple manner introduce those great secrets which seem to excite no wonder in the young mind, and certainly no prurient curiosity. To the pure all things are pure. To the child all things are full of wonder, beauty, and God. How much better to let the young mind become familiarised with these great laws before the sexual instincts awake, which may invest them with lower associations, as viewed from the selfish and sensual standpoint.

The wonderful results of scientific research, which have been unfolded in the recent medical congress, suggest the near advent of a time when science will be able to cope with one of the most terrible foes of human, and especially of domestic, happiness. What effect will be wrought on the continence of the community when the further advances, now foreshadowed, have been made, we cannot forecast; but the great principle remains unchallengeable, that our nation will be saved, not alone by hygiene or segregation, not by notification or palliative remedies, but by beginning with the springs, as it is recorded of the ancient prophet, who went forth unto the spring of the waters, and cast salt therein, and they were healed.

F B Meyer

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INTRODUCTION

ALTHOUGH this book is written to children, and contains nothing which may not be put freely into their hands, the author would, at the same time, like to point out how great is the loss to both mother and child if the subject to which it relates is not personally discussed between them. In any case children ought to be given facilities for procuring and help in looking at the natural objects herein referred to.

She would also like to call the attention of parents and teachers to the fact that in many children a thirst for knowledge concerning life and its sources long precedes interest in inanimate things; and that, as healthy curiosity is nothing but the natural appetite of the mind for knowledge, this instinct ought to be respected and satisfied.

As far as possible truthful answers should be given to reasonable questions, and then " You must wait till you are older to know more " will be accepted in faith and patience.

The Spring

LIFE
AND ITS BEGINNINGS

CHAPTER I

THE SPRING

EACH year, when the darkness and cold of the winter are passing away, and the mornings and evenings are growing longer, there comes every now and then a beautiful warm day, when the sunshine makes us feel what a delight it is to be alive. On such days we are aware of the teeming life of the earth stirring around us.

We say one to another, "This is a day to begin sowing seeds," and we get out the dry beans which have been kept over from last year's crop, to supply that of this year. We feel that underground the plants which have been sleeping all the winter, resting and storing up food and strength, are now beginning to awake. They are pushing up little shoots towards the sun and the air. If we look at the trees we notice that the leaf-buds are swelling. Soon they will unfold and open into tufts of green leaves.

Among the branches the birds are beginning to sing and rejoice, calling to each other and saying that the time is coming for life and long days, for the building of nests and the glory of the year.

The snails crawl out of the holes where they have lain during the winter, and one day the squirrel puts out his head and realises that life is again worth living. In the ponds we notice great jelly-like masses of frog-spawn, which will soon turn into tadpoles and later into frogs.

All creatures, in short, seem to be getting ready to increase and multiply. Even in the towns we are aware of the Spring; indeed, it almost seems that the contrast of the young green leaves against the dark, grimy bark of the town trees is even more striking than in the country, where their surroundings are cleaner and fresher. In every remote corner a wonderful message has been received by all living things, telling them that they are to wake up to life, and rejoice together.

Thou visitest the earth and waterest it;
Thou greatly enrichest it with the river of
God, which is full of water:
Thou preparest them corn,
When thou hast so provided for it.
Thou waterest the ridges thereof abundantly;
Thou settlest the furrows thereof;
Thou makest it soft with showers:
Thou blessest the springing thereof:
Thou crownest the year with thy goodness;
And thy paths drop fatness.
They drop upon the pastures of the wilderness;
And the little hills rejoice on every side.
The pastures are clothed with flocks;
The valleys also are covered over with corn;
They shout for joy, they also sing.

Psalm lxv. 9–13.

What Living Things are Made of

CHAPTER II

WHAT LIVING THINGS ARE MADE OF

ALL living things, even the simplest and humblest, whether they are plants or animals, differ from those which have not the great gift of life, in being able to do certain things which the others cannot do.

We all have some idea what we mean when we say anything is "alive." Perhaps our first thought is that it can move. This is quite true; but many plants, for instance, can move so little that it is hard to believe that they really do so at all.

Neither are we sure that they can all feel.

Perhaps the most important peculiarity of living things is that they grow by taking food into their own bodies, where they are able to turn it really and truly into themselves. This is quite different from the way things grow which are not alive.

We sometimes, for instance, dissolve alum or some other crystallised substance in boiling water, and then, as the water cools, watch the clear crystals re-forming either at the sides of the basin or round a thread or other object which we have placed in the liquid. One beautiful crystal becomes added to another, and the thing grows under our very eyes.

Growth like this, of anything that is not living, can only take place when the exact material is there ready for use. The alum is in the water in liquid form, and as the crystals grow it just separates and becomes solid.

This crystallisation is a very wonderful and interesting thing to happen, but it is altogether different from the way plants and animals grow.

If we have a little plant growing in earth, and give it water and sunshine and fresh air, it gets bigger every day because it finds food in the soil and in the gases in the air. It takes these in through its roots and leaves, and has power to turn them into its own substance, and so grow larger from inside.

It is the same with young animals.

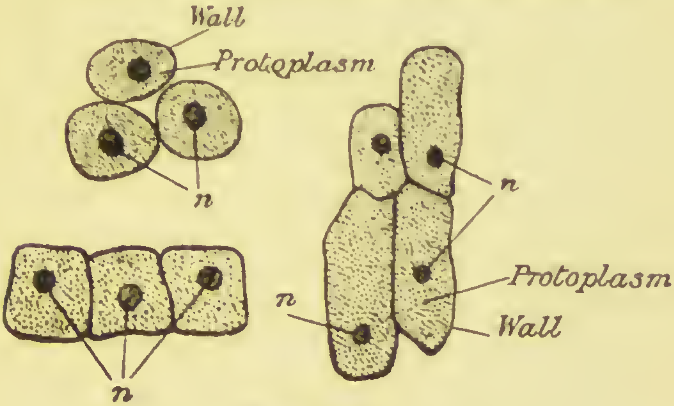
When we have a little puppy-dog or kitten, and give it food every day, the bread-and-milk it eats ceases to be bread-and-milk, and turns into puppy-dog or kitten, as the case may be. It grows and grows, and before long, instead of being a pup or a kitten, is a dog or a cat.

This is part of the great miracle of life.

Living things have this wonderful power of feeding and breathing and growing, because they always have in them a very special substance called *protoplasm,* a name which means "*the first material for making things.*"

When seen by itself, protoplasm is a kind of colourless jelly-like stuff, half fluid, and somewhat sticky and slimy. It is destroyed by great heat or cold, and always needs a certain amount of moisture to keep it going. If it dries up it dies.

If we take a little thin slice of the stalk or leaf of a plant and look at it under a microscope we see that it consists of a number of little compartments lying side by side, fitting beautifully one against another. These tiny bricks, of which the whole plant is made, are called cells. The people who



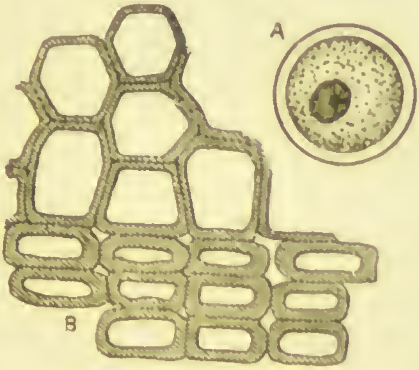
Plant Cells.
In each case *n* indicates the nucleus.

first noticed them gave them this name because they thought they looked so like the cells of a honeycomb.

Each fresh plant-cell is a minute atom of protoplasm, soft and half liquid inside, and surrounded by a harder and firmer covering which separates it from its next neighbours, and looks like the mortar between the bricks.

We all are acquainted with houses of many kinds and shapes, as well as churches and bridges, and ever so many different varieties of buildings which may yet all be made of bricks. In the same way there seems to be no end to the different kinds of plants which are in the world. Most plants, too, have many different parts, and yet all of them and all their parts are made up of protoplasmic cells.

Some of the cells are larger, and some are smaller, some are juicier, and have more of the soft central protoplasm, with very thin covers. In others the walls have become thick and hard, and the protoplasm has nearly or quite disappeared. These last are the hard older cells which make up the wood of trees.



A. Cell, with wall, protoplasm, and nucleus.
B. Dry empty wood cells, without nuclei.

Inside the young fresh cells such as we find in the pulpy parts of plants we can, with a microscope or magnifying glass, see other things. There is nearly always a smaller round lump inside each called its *nucleus*. Remember this name, because the nucleus plays a very important part in the story of cells, and of everything which is composed of them.

And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters.

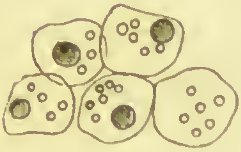
From the Book of Genesis.

What Cells Can Do

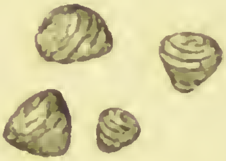
CHAPTER III

WHAT CELLS CAN DO

IN the cells of those leaves and stalks of plants which are exposed to sunlight we find a number of little round bright green granules. These are a stuff called chlorophyll, which plant-protoplasm alone can make; and then only when it has the help of the sun. Plants which are kept in the dark get pale and white, because it is impossible for their cells to make the beautiful



Cells with Chlorophyll Granules.



Starch Granules.

green colour unless the sun can get in to work with them. Very much in the same way children grow pale and white if they live in dark towns and have not fresh air and sunshine.

With the help of chlorophyll the protoplasm of plant cells can also make starch, which is stored inside the cells until it is wanted either as food for the plant itself or for the animals which live upon the plants.

The starch, too, can turn into sugar, and that is what makes ripe fruit sweet. The big juicy cells of which the fruit pulp consists have sugar in them. The large cells which make up a potato are crammed full of starch, and are so big that if you cut it across you can see them without a magnifying-glass. At the dinner table when a nice dry floury cooked potato is put upon your plate, the "flour" we speak of consists of these great cells full of starch, which the boiling water has swollen still bigger, and separated from each other.

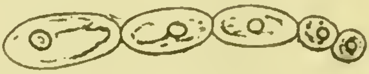
There are also some parts of certain other plants in which it is

The Spider-wort.

very easy to see the cells, because they are large and more separate from each other.

There is a pretty old-fashioned blue or white flower called spider-wort, which is found in many country gardens. If I draw you a picture of it I am sure you will recognise it at once.

In the centre of this flower there are a number of beautiful violet hairs. If one of these is put under the microscope we see that it is made up of a line of big cells like beads on a string, very beautiful and easy to observe.



Hair from the Spider-wort, showing Cells.

You could not have a better

example of plant cells. There we see the big nucleus, and the protoplasm of the cell round about it, with juice of a violet colour. If the microscope is a good one we shall even see the protoplasm moving about round the cell in streams. All living protoplasm inside vegetable cells moves in this way, though it is generally much more difficult to see than in this curious spider-wort.

There are some water-weeds which have even larger cells than these, and in which the protoplasm is very clearly seen streaming about and carrying granules of chlorophyll with it.

All animals as well as plants are built up of protoplasmic cells, most of which, however, have thinner, softer walls. Animal protoplasm itself must be a little different from that of the plants, for it cannot manufacture chlorophyll. This makes really a very great difference. It means that animal cells cannot, even with the help of the sun, get food from the simple minerals of the earth, as plants do, but have to wait for the vegetable cells to prepare starch and sugar for them, as well as another kind of food which they need, called protein.

The plant cells are like some wonderful people in a fairy tale who have a magic secret. They know how to make the sun help them. Working with him they can turn lifeless things into living protoplasm. The animal cells have not this secret, so they must wait patiently to be served by the plants.

So all through the universe one thing owes its life and well-being to another. You will see presently how, without the help of animals, many plants would soon cease to exist!

There is something else I must tell you about all kinds of living cells, and it is just as important to the continuance of the miracle of life as feeding and breathing are. It is that they have the power to increase in numbers, so that as some die off there are others to take their places.

When each living cell, in a part that is growing, has fed and breathed for a time it splits into halves, so that where there was one cell before there come to be two. Each of these in its turn feeds, and breathes, and grows, and if no accident happens, it also divides. In this way, after a time, what was, to begin with, one cell becomes a multitude which cannot be counted ; and thus the whole plant or animal, built up of cells, goes on growing larger and continues to live in spite of wear and waste.

Praise to Thee, Lord, with all Thy creatures; and above all to
Brother Sun, who makes the day and lightens us.
Fair is he and shineth with a great splendour.
Most High, he bears the mark of Thee.

"*The Lauds of Creatures,*" *by* ST. FRANCIS OF ASSISI.

Some Primitive Animals and Plants

CHAPTER IV

SOME PRIMITIVE ANIMALS AND PLANTS

If some water is taken from a quiet pond such as those where many water-plants grow, and where frogs and fishes have their homes, and is examined under a microscope, most wonderful things are seen.

The greater number of the animals and plants we know best are composed of thousands of cells, of many different kinds. There are, however, others which consist of only a few, and many creatures are formed of but one cell.

These last are, of course, very small. They nearly always live in water, and to see them properly one needs, for the largest, a strong magnifying glass, and, for most, a microscope.

If one water-drop is taken from near the mud at the bottom of the pond, it will contain the greatest number of treasures.

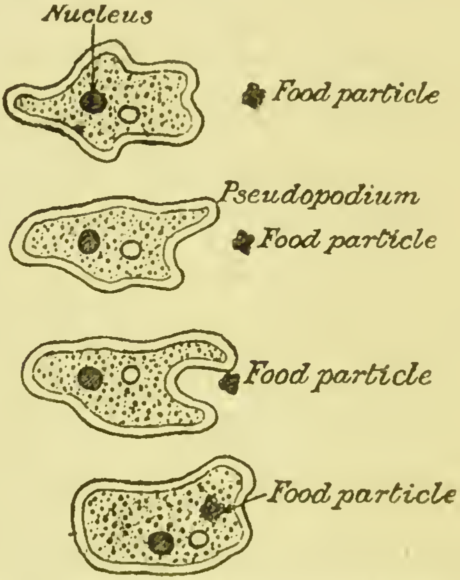
Looking into such a drop we enter a world where dwell quite different inhabitants from those we are accustomed to see. Moreover, they are all busy about their own affairs, and seem as sure as we are that their doings are the most important in the universe.

Some little things are active and swim about, while others remain quiet. It is often hard to say which of them are plants and which animals. If we see a number of green chlorophyll granules in any of them we may suppose them to be plants, busy making food for themselves and for the animals. They may, however, be animals who have eaten some chlorophyll!

If we search carefully, and are lucky, we shall very likely soon meet with an irregularly shaped lump of clear protoplasm of no particular shape called an *Amœba.*

Its outline will be very like that of some little island on a map. It will have ins and outs round it like bays and peninsulas. Sicily is the island they oftenest remind me of.

This creature appears to be the simplest real animal with which we are acquainted. It is only a lump of protoplasm, and yet it does all the things which are expected of animals. It eats plants and other animals, choosing its food, and leaving what it does not want; it breathes, and it moves about. It also increases in number.



Amœba changing shape and flowing round food.

If we examine this creature we can observe everything which goes on inside it, for it is quite transparent.

First we notice that all round the edge is a clear line. This is the outer covering of the cell, which is a kind of skin to the animal. Inside that we see colourless granular-looking protoplasm, and somewhere in this we find a distinct round or oval nucleus.

A clear space may generally also be seen which looks like a little lake in the island. We may notice that this grows larger and smaller as we watch. Here and there, too, we may see scraps of plants and animals which the Amœba has taken in for food. Round some of these there will very likely be other little clear spaces, because it has taken in some water with the solid food.

By the time we have seen all this

we shall have found out that the Amœba is never exactly the same shape for a moment at a time. It puts out a new peninsula, and presently the whole animal flows along into that, and so the creature moves, and the peninsula disappears.

These legs which I call peninsulas, are really called *pseudopodia,* which means *false feet.* The Amœba has no real feet or legs, but can make a leg or an arm whenever it wants it, and draw it in when it has served its purpose, just as if it were something in a fairy tale.

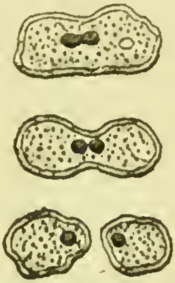
If one of these *pseudopodia,* as it stretches out, touches a little plant or animal or anything which would be good for food, the Amœba puts out a second limb, and the two catch hold of the prey and draw it right into the protoplasm of its body. Then, when as much as it wants is digested, the useless parts are passed out again from the surface of the creature.

If one of the false feet touches something which would be no use to eat, it does not take hold of it, but just shrinks back from it as a snail draws in its horns, or a sea-anemone its feelers, if we touch them. The Amœba seems quite able to feel, and in some way to know what is good for food, and what is not suitable to eat.

The clear space which grows larger and smaller is supposed to pump out waste material which is no longer required.

When an Amœba grows too big

it turns into two in the following way. First of all the nucleus (that is the more solid part in the middle, of which I have told you) becomes

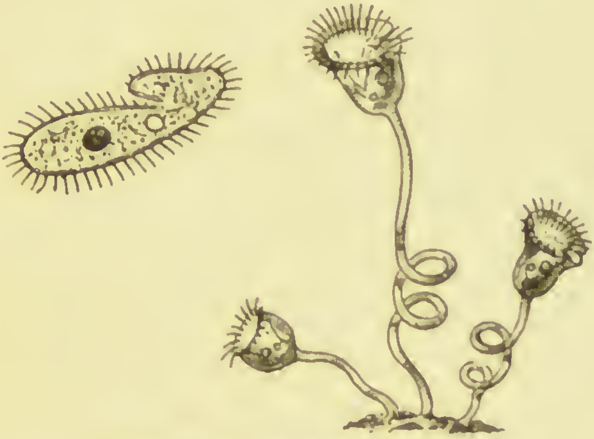


Amœba dividing.

the shape of the figure eight. Its waist gets thinner and thinner, and soon it divides into two. After that the rest of the protoplasm also divides, half going round one piece of the nucleus, and half round the other; and so there come to be two Amœba instead of one.

This is the way nearly all cells divide, whether they belong to plants or animals. The division begins in the nucleus, which is the most living part.

There are a great number of other microscopic animals living in water which consist of only one cell.



One-celled plants and animal.

None of the others that I know of, however, change their shapes quite to the extent that the Amœba does.

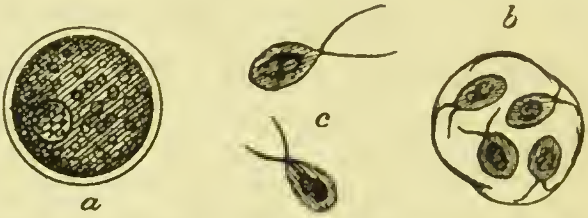
They are generally much more active and lively than it is, and not so easy to watch. Many of them travel about by waving or lashing long feelers or whips of protoplasm, which move something like the oars of a boat. They also have more definite mouths than the Amœba, and do not, as the latter does, take in their food just anywhere that it happens to touch them. All are the same, however, in having a nucleus, and they multiply by dividing into two or more parts. Some fasten themselves to other things by stalks, and look like plants.

To many of these one-celled animals another thing sometimes happens. Two of them come close together and turn into one. The two nuclei become one nucleus, and the protoplasm of both becomes mixed, so that the new animal looks exactly like the others except that it is a little larger and stronger. In due time it also splits up again just as the rest do.

There are many plants as well as animals which consist of only one cell, and I must tell you something which is particularly interesting about one of these. It is called the *Hæmato-coccus.* The name may look a little difficult at first, but it is not really a bit harder to remember than "Birmingham" or "Constantinople," when it has been repeated over a few times.

The Hæmato-coccus is sometimes bright red and sometimes bright green, and though each separate one requires a microscope to see it, great quantities together show the colours well.

The red or green slime we sometimes see in rain-water pools on the road, when we are out walking, is made up of millions of these little one-cell plants. Red patches on the snow in Arctic regions, of which travellers tell us, also consist of millions of the red kind.



Hæmato-coccus. *a*, Resting Form; *b*, Dividing; *c*, Active Form.

As soon as the water dries up these little cells dry up too, and are carried about in the dust till more rain comes.

The very interesting thing is that they have two forms or shapes. One is a lively, active form which suits their life in the water, and the other a resting, sleeping form which can keep alive when quite dry in the road-dust.

The resting shape is as round as a ball, with a quite hard covering which keeps the protoplasm inside safe and moist. It contains, of course, a nucleus like all living cells, and also grains of chlorophyll or red stuff similar to chlorophyll, on one or other of which its colour depends.

If, when the rain comes and lays the dust, we get a drop of water from one of the pools on the road, we shall probably be able to find some of the round resting cells.

When the little plants have been a short time in the water and sunlight, the nucleus divides in two, and then into four, the outside shell bursts, and out swim four little oval things which it is hard to believe are not animals. Each has a pair of long lashes made of protoplasm with which it rows itself about, travelling quite actively in the water. Except for the little opening where these lashes pass out, at one end of the oval, the active Hæmatococcus is covered with nearly as firm a skin as that of the resting mother cell. It has, like other cells, a nucleus inside, surrounded by protoplasm, still containing chlorophyll.

Instead of dividing into only four, before it bursts, the nucleus of the resting cell divides into ever so many, and lets out a whole brood of much smaller lively little oval swimming cells. Pairs of these often join together to make one in the same way that I told you the little animal cells did. Like them also they later divide again into two.

When the active Hæmato-cocci have swum about for a time they take another rest, and change their shape to do so. The lashes disappear, and the cells become round and quiet. Then, when the pool dries up many are ready to sleep while the wind carries them about, until they again find themselves in water on a rainy day, and then begin the same round all over again.

There are also many one-celled animals and plants which can take up lime or another mineral called silica from the water they live in, and make them into the most beautiful shells to cover them, or skeletons to support them. These shells and skeletons are some of the most beautiful things in Nature, and many pictures of them can be found in books on zoology. They are generally pierced all over by little holes through which, when the minute creatures were alive, they sent out long lashes of protoplasm with which they moved, and felt whatever they came against, and caught and drew in their food.

Chalk, which we use so much for drawing on blackboards, is altogether made up of little fossil shells of this kind. There are thousands and millions of them in any little bit of it. Think how many there must be in the chalk cliffs on the south coast of England.

There is really no end to the wonders which can be told of the thousands of varieties of little one-celled creatures. I can here give you only these few examples of them and their peculiarities. If we want to know more, as we all do, there are numbers of interesting books written about them which we can read. Even when the books themselves are very difficult the pictures are delightful to look at. Some of the loveliest are to be found in Haeckel's books, and if ever you have an opportunity I advise you to try to draw some of them.

O Lord, how manifold are Thy works!
In wisdom hast Thou made them all:
The earth is full of Thy riches.
So is this great and wide sea,
Wherein are things creeping innumerable,
both small and great beasts.

* * * * *

These wait all upon Thee;
That Thou mayest give them their meat
in due season.
That Thou givest them they gather:
Thou openest Thine hand, they are filled
with good,
Thou hidest Thy face, they are troubled:
Thou takest away their breath, they die
and return to their dust.
Thou sendest forth Thy Spirit, they are
created:
And Thou renewest the face of the earth.

Psalm civ. 24–25, 27–30.

Division of Labour

CHAPTER V

DIVISION OF LABOUR

WE have seen that in the Amœba and Hæmato-coccus, and other simple animals and plants, one cell is able to do everything which we expect of a living thing. It can breathe, and move, and take in and digest food, and grow and divide, and seems also able to feel. It is hard to imagine so many powers in so small and simple a creature.

There are other plants and animals which are just like a number of single-celled creatures fastened together. That is, each cell carries on its own life, breathing, and feeding, and dividing, but can only move about with all its neighbours to which it is attached.

The protoplasm of each cell of such a creature may be compared with a number of people each occupying a separate room in a house, and each doing everything for himself, cleaning, shopping, cooking, etc., and yet each doing it exactly in the same way as every one of his neighbours.

It is easy to see what an advantage it might be, in such a household, if some people took one duty, and some another; if some cleaned the house, and others went out to find food, and others cooked, and some rubbed the furniture, and another set worked in the garden.

This is called "division of labour," and we find an arrangement like it in the higher plants and animals which are composed of a number of cells.

The cells become arranged in groups, each of which has its separate duty, instead of everything being done by all. In this way all the processes of life are carried on better than without division of labour.

In plants some cells form the roots, which drink in water and minerals from the earth, some the green leaves which spread themselves to the air and sunshine, making chlorophyll and starch, and breathing in the way plants breathe. In the fibres of the stems the soft moist protoplasm disappears from the cells, and their walls grow hard and firm. This makes the plant able to stand up strongly. These fibres are covered by a layer of particularly juicy and living cells under the outside bark. These divide readily and thicken the growing stem. The bark outside them is hard, dry, and practically dead.

In the fibres the sap runs up, carrying water and nourishment to every part of the tree or plant, and in the inside part of the bark it flows down bringing the food-stuffs which the leaves have manufactured. So the roots and the leaves nourish the whole plant.

To special cells is given the duty of making new plants. Near the tips of the roots and stems, as well as at other places throughout the plant, there are spots where the business of the cells is to divide rapidly and so to lengthen out the part and make the plant grow. These are called growing points. Their cells are very full of juicy protoplasm, and the nuclei are very ready to split up and increase in number and size. So the stalks lengthen, and buds come, to unfold into leaves and flowers, which all grow and expand, increasing the size of the whole plant.

In other parts of plants the cells act as storehouses for food. Potatoes, which are really underground stems, are, as we have said before, great storehouses of starch which the plant has put away for its own use. Every big, thin-walled cell of which they are made up, is bursting with starch granules, which have been carried down from the chlorophyll of the leaves.

If we grate an uncooked potato on a nutmeg-grater, we break up the cell walls, and if the gratings fall into water, we can see the starch dropping down to the bottom of the vessel as a white powder. We can even use it to starch linen with, or to make arrowroot to eat.

In a potato, too, we have very good examples of growing points. Here and there over its surface we see little dimples. From each of these, if it had been left in the ground, stems would have grown, using up the store of starch, and producing more potatoes, and more fibrous roots.

Gardeners call these little dimples "eyes," and it is from them that they grow the crop for the next year. Some potatoes are kept over, and cut up in such a way that one or two eyes will be in each piece. Then they are covered up in the earth and from them the new plants sprout out. If you take one and keep it in the light you will see for yourself what happens. The potato will then become green, and make chlorophyll instead of storing starch, and stems and leaves will grow from it.

Something similar occurs when we grow more carnations or roses or other plants for our gardens from what are called "slips." At the time of year when we know that the stems are lengthening fast, we cut off a little branch of the tree or plant just below a growing node, remove the lower leaves and put it in very nice fine earth. If we keep it watered and shaded from too hot sun, another wonderful thing happens.

Presently the growing point seems to find out that it is in the dark under the ground, and not out in the air and light, and then it shoots down roots instead of sending up branches and leaves. In this way we have in a short time a little separate plant able to grow by itself.

It is only certain varieties which can be grown from slips and cuttings. The usual way of getting new plants and vegetables for our gardens is by sowing seeds. These can be obtained from all flowering plants and trees. We can save them with care from our own plants, or buy them from florists who have taken the trouble for us. It is much more interesting to do the former.

For the body is not one member, but many.

If the foot shall say, Because I am not the hand, I am not of the body; is it therefore not of the body?

And if the ear shall say, Because I am not the eye, I am not of the body; is it therefore not of the body?

If the whole body were an eye, where were the hearing? If the whole were hearing, where were the smelling?

But now hath God set the members every one of them in the body, as it hath pleased Him.

From the First Epistle to the Corinthians.

Flowers and Their Children

CHAPTER VI

FLOWERS AND THEIR CHILDREN

Now, what are seeds, and how do the plants make them? These are most interesting questions, and here is a great deal to be told in reply to both of them. I shall do my best to tell you.

In the division of labour among plant-cells there are some in the growing parts which are destined to become flowers; and down in the centre of the beautiful flowers the little seeds are formed, and kept safe till they have become quite ripe.

If we examine almost any simple single flower, we shall readily see that it is made up of leaves. These are not like ordinary green leaves whose duty is to make chlorophyll, but are altered so as to be useful in other ways, and serve special purposes.

In most flowers we find four circles of different kinds of leaves, one inside the other. Let us examine a flower and see what these leaves are for.

Beginning at the outside there is

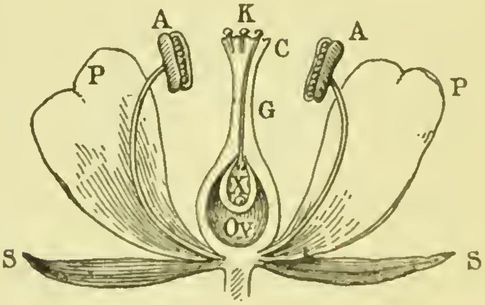


Diagram of the Flower, with its four circles of leaves. S, Sepals of calyx; P, Petals of corolla; A, Stamens with anthers on top; C, the Stigma; G, the Style; K, Pistil made of carpels with Ov., ovary, with three pollen grains. The tube of one of these has reached the seed (X) to fertilise.

a circle which is known as the calyx (S, in Fig.). Its leaves, called sepals, are generally green. Sometimes they are partly joined together forming more or less of a tube, as in the primrose or cowslip. In other flowers, as the wallflower, they remain separate. The duty of the calyx is to protect the more delicate inside parts of the flower, and when the buds are young its leaves entirely cover up all the rest. As the flower opens they separate, and let out the inner circles.

Inside the calyx we find a circle of beautiful coloured leaves called petals, making up what is known as the corolla (P, in Fig.). These are also sometimes joined into a tube, generally at the lower part only. They are usually separate, at least at the tips. The coloured corolla is not only very lovely to look at, but it also attracts insects which, as I shall presently explain, are very useful to the plants.

Inside the corolla we see the third circle. It is made up of the stamens (A, in Fig.). These are generally fine threads, each carrying on the top two little boxes or cases formed of rolled-up parts of leaves. These cases are called the anthers, and when the flower is ripe they open and let out a quantity of dusty pollen, with which everyone is familiar on full blown flowers in which it is quite ripe.

Pollen is generally a yellow powder, although sometimes it is brown, or red, or some other colour. Many of us know the red-brown dust on the stamens of some beautiful lilies. Each grain is a cell or spore, very like some of the minute one-celled plants we saw in the drop of pond water, when we examined it with a magnifying glass.

Quite in the middle of the flower we find what is called the pistil (K, in Fig.). In shape it often looks like a bottle, large below and getting narrow above, and somewhat larger again at the cork or stopper. This pistil is really made up of the inside circle of leaves called the carpels, often fastened together at their edges.

The wide part of the bottle below is called the ovary or egg-case (OV., in Fig.). It is hollow inside. The part which represents the neck of the bottle is generally solid and is called the style (G, in Fig.). Its upper part, looking outside like the stopper, or cork, is known as the stigma (C, in Fig.). The stigma is nearly always sticky, and is generally rough and irregular of surface, or has hairs on it. Down in the ovary are found the seeds (X, in Fig.), from which new plants are to grow. There they ripen, till, when they are ready, the ovary opens to let them out, and they scatter all round.

A perfect seed, when fully made, consists of three parts. These are (1) a firm case or covering, called the seed-coat, (2) a little undeveloped baby plant, (3) a supply of food for the little plant to live upon from the time it wakens up till it is able to make use of the materials it finds in the earth where it has settled.

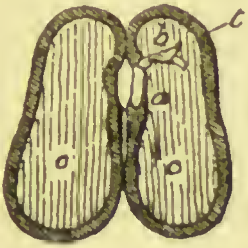
The seed is first an ovule or

little egg in the ovary. One cell of this is to make the baby plant, but it cannot do so until its protoplasm has been joined with that of the pollen of another flower of the same kind, which gives it the power to grow.

This happens in this wise. In the depths of nearly all flowers there are some cells where honey is stored, and others where sweet scents are formed. Bees and other insects, attracted by the colour and smell, and desiring the honey, come to seek it. As they push into the flowers to reach the honey, the pollen from the stamens gets caught upon the hair on their bodies, and so they carry it to the next flower. There some of it is rubbed on to the stigma or sticky top of the pistil which we have compared with the stopper of a bottle.

Now a most wonderful thing occurs. When a pollen cell finds itself on the sticky stigma of a flower of its own kind, it begins to put out what looks like a little root. This is a tube which grows down through the solid style towards the ovary where the ovules with the egg-cells are (*see* Fig., p. 62). To one of these it brings the nucleus of the pollen cell. Then the two make one cell which has the power of dividing and dividing over and over again, until it becomes a little mass of cells. These become the very youngest baby plant which one can imagine. It is called an embryo, and consists of a tiny root, and minute flat-folded leaves.

Other cells which are also in the ovule become stored with plant-food, and are generally formed into the cotyledons or seed leaves (*see* Fig.). These, with the embryo, are packed away in the tough outside seed-cover, where all remain dry and hard, till some day moisture and warmth awaken the baby plant and it begins to grow again, and becomes a plant like that from which the seed came.



French Bean.

_a_, Root ; _b_, Leaves ; _c_, Cotyledons ; _t_, Seed-coat.

The mixing up of the pollen protoplasm with that of the egg-cell is called the fertilisation of the seed, because it makes it fertile, or gives it the power to become a separate creature. Seeds which have not been fertilised never come to anything.

It has been noticed that plants are stronger and healthier, and in other ways better, when the seeds they grow from have been fertilised by pollen from the flowers of a plant different from the one which provides the ovule. This is why the work done by insects is so important, and why it is well to have several plants of the same kind near together.

At first sight it looks so easy and convenient for the stamens, growing round close to the pistil, to give it some of their pollen. As a matter of fact, however, in many flowers the pollen is not ready at the same time as the ovules are ready for it. In others there are special arrangements to hinder their own pollen from getting on to the pistils, and so to their great advantage they become dependent on insects. If you examine a primrose you will find that if the pistil is long the stamens are short, and vice versa.

Some seeds can be kept an immense time asleep, as it were, then, when they are put in the right conditions they will begin at once to grow. Others have to be sown almost at once or they will die. I have heard that coffee-beans cannot be grown later than a few days after they have been gathered ripe from the trees. Most seeds can be kept at least till the following season, when we generally sow them in the garden.

The three things which seeds require to make them grow are moisture, warmth, and air. Some need more and some less of each of these, and people who cultivate them have to find out their tastes.

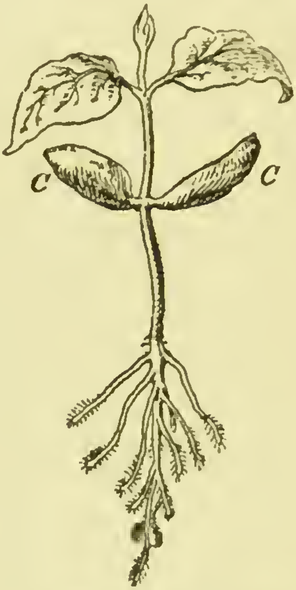
Till water soaks in, the little embryo cannot make use of its food-supply; if it is not warm enough it does not waken up; and we know that air is necessary because seeds which are buried too deep in the ground, where air cannot get at them, rot instead of germinating. The roots of plants in pots which are too much watered, also die from want of air.

Suppose, now, we take some real

seeds and examine them, and watch some of them growing. It is best to choose something large enough to be easily examined and handled. Nothing is better than a bean or a pea. Wheat and cress are also good. All these have a nice store of food to go on with and can be grown on damp moss, or even wet flannel on a plate. This last is the way cress is often grown.

When a dry bean is soaked in water the first thing that happens is that it swells up and looks bigger and plumper. The water soaks in through a little pore in the covering. If from a bean so softened we peel off the skin, we find the two solid seed-leaves with their flat sides fitted against each other, and forming a kind of hinge where they are joined together by the little white embryo plant, pressed in between them.

Let us place a few beans on damp moss where they will be kept wet all the time. When the water has swollen them out the pressure inside will crack the tough skin, and out through it downwards will come the tip of



French Bean Growth.
c, Showing the shrivelled cotyledons.

the little growing root, and presently upwards the leaf-bud of the plant will appear, with its pretty little plume of folded leaves.

As the plant grows the seed-leaves become smaller and more shrivelled. This is because the store of food which they contained is being used up by the little plant, so while it increases they must decrease. The tough seed coat burst open by the cotyledons soon dries up and falls away.

Though air, water, and warmth are all the plant requires in order to grow, it also needs light to make it healthy and able to carry on its important business of chlorophyll making. As the little plume of leaves shoots upwards from our bean, we notice that it becomes bright green. This, as we know, means that it already has the help of the sun in manufacturing chlorophyll granules. If kept in the dark it will grow, though it will not become green, but will look pale and sickly.

When all the store in the seed-leaves is used up our little plant will need to have nourishment which its roots can suck up. This it finds best in moist earth, though some kinds can be grown in water to which certain substances have been added. Bulbs such as hyacinths, which have good food stores of their own, we often grow altogether in water without earth.

Be sure to look inside grains of corn, too, and find their embryo and food store. The latter is the very food with which they supply us, for it is this we grind into flour to make bread. A grain of corn has only one seed-leaf, and the embryo is not connected with it exactly as it is in the peas and beans. You will, however, easily find the two lying close together, and can readily separate them.

I hope you will also grow cress on wet flannel ; and any other kinds of seed you can get.

There are many other interesting experiments to be made with seeds, and a great deal more to learn about them than I have been able to tell you here. In books on the life-history of plants you will find out all about it, and with very simple arrangements you may watch a vast number of marvellous things.

BABY-SEED SONG

Little brown seed, O! little brown brother,
Are you awake in the dark?
Here we lie cosily, close to each other:
Hark to the song of the lark.
"Waken!" the lark says, "waken and dress you;
Put on your green coats and gay;
Blue they will shine on you, sunshine caress you—
Waken! 'tis morning—'tis May!"

Little brown seed, O! little brown brother,
What kind of flower will you be?
I'll be a poppy—all white, like my mother;
Do be a poppy like me.
What! you're a sunflower? How I shall miss you
When you're grown golden and high!
But I shall send all the bees up to kiss you;
Little brown brother, "Good-bye!"

By kind permission of E. NESBIT.

Some Water Babies

CHAPTER VII

SOME WATER BABIES

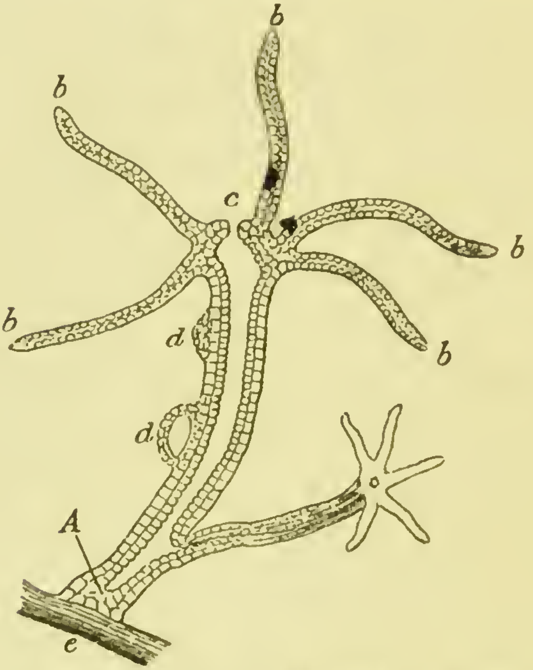
THE division of labour among the cells of animals' bodies is carried to a much greater degree than in plants. Animals also move and feel more and can do a great many more different things. All but the very simplest can see and hear. They therefore want muscles to move with, nerves to feel with, eyes with which to see, and ears which can hear. Each one of these requires many different kinds of special cells to build it up. The skin alone is made of several layers of different kinds, and a variety attend to digesting the creature's food. Many more are busy getting rid of waste material which is no longer wanted, and would only do harm if it remained in the body.

In all animals, as in all plants, there are certain groups of cells whose special duty is to develop into the next generation. These are generally placed very safely because so much depends on keeping them from any harm.

There are numbers of animals, however, in whom the division of labour is less complicated than in those I have referred to. They are nearer to the one-celled animals than to the back-boned creatures, which are higher up in the scale of life.

If we get the stalks of some water weeds from such a pond as that in which we found the amœba, and place them in water and look at them carefully, we may find a very simple animal, a little jelly-like creature which is called a hydra. It will be an inch long, or less.

On first seeing the hydra we might mistake it for a plant, because it is attached to a stem by what looks like a stalk. It is really only holding on to it by a kind of sucker, like those by which the beautiful sea-anemones in seaside rock-pools fasten themselves to stones. Indeed, the little hydra is a humble cousin of the sea-anemone, and is like it in many ways. It is, however, more simple in its build. Either of them can, at any time, unfasten itself from the place where we see it fixed, and move off to settle somewhere else. They can keep themselves so tightly stuck in their places, however, that we cannot separate them from the rock or plant stalk without badly damaging the animal.



Hydra.—*A*, Body; *b*, Tentacles; *c*, Mouth; *d*, Baby hydra bud; *e*, Stalk of plant.

This "stalk" is really the body

of the hydra, which is a long, hollow tube, with a mouth at the top, and is made up of (1) an outside layer of cells set side by side, forming the skin. This protects and feels, and is lined by (2) another layer of cells, also placed side by side. These last cells digest any food brought to them through the mouth, at the top of the tube, by big, long feelers or tentacles, which are arranged round it like a star. The tentacles can feel and grasp, and if they touch anything which they do not like, they shorten and draw themselves in. They, too, are made up of cells, which have the power of movement, and many of them can put out lashes of protoplasm to feel, and cling better to what they want to capture for food.

They are also able to give other animals slight electric shocks.

Near where the sucker attaches the animal to the plant, we very often see a little baby hydra, which has grown out like a little bud or branch. When it is big enough this will separate from its mother, and swim away with its tentacles, to fix itself by its sucker somewhere else, and lead an independent grown-up life, wherever it finds a nice place to settle.

Besides budding out young ones in this way the hydra also has on it two other kinds of cells. These separate from the parent, and if one kind meets the other in the water they join together and make one cell, with one nucleus. This divides and divides without breaking up, and gradually grows into another young hydra, exactly like the ones which have budded off. This reminds us of the way in which plants can be increased both by cuttings and by seeds.

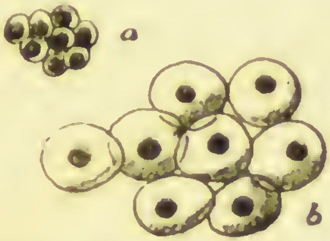
As an egg-cell of the hydra divides and divides again, some of the new cells make the skin, others the lining of the body, which digests its food, and some the tentacles, while yet others have the duty of waiting till they are wanted to grow into another generation of hydras.

There is a great distance between plant-like animals of this kind and even the humblest of those which have back-bones and brains. Perhaps of these last the simplest which you know are the fishes, which have scales and live altogether in the water. They there breathe the air dissolved in it, with gills or slits at the sides of their necks, instead of taking in free air through nostrils into lungs, as we do when we breathe.

Most fishes lay an enormous number of eggs in the water where they live, putting them in the safest places they can find. Some, like the stickleback, make quite beautiful nests for them, but most eggs have to take their chance, and many are eaten up by water-creatures before the young ones have grown in them.

When we look about in the ponds in March and early April we find great masses of what is called frog-spawn, made up of a clear jelly with little black spots dotted through it at equal distances from one another.

If we look carefully we shall see that each black dot is in the middle of a ball of clear jelly, and that the whole mass is made up of these placed side by side. Each ball is a frog's egg, and its black spot is the part which is quickly growing into a tadpole, which will later become a frog.



Frog-spawn.—*a*, Just laid ; *b*, Swollen in water.

These eggs, like all others, were first cells in the body of the mother frog. She put them in the water and the father frog brought more cells which joined with the others to make it possible for a living animal to develop from them.

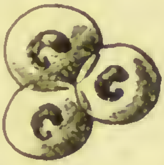
When the eggs are first laid they look just like a mass of little black dots, but as they lie in the water the stuff which surrounds each swells up, becoming big and clear as we best know it. This soft envelope protects the growing baby tadpole from knocks and blows, and from some of its many enemies.

If we get a big glass jar or a dark-coloured basin full of water, and put in it some stones and weeds out of the pond, and then some frog-spawn, we can bring it into the house and watch the little black dots turning into tadpoles.

I especially say a dark-coloured

basin, because if tadpoles are put in a white basin they die. I have never heard the reason of this calamity.

By this time we have a shrewd idea of what happens in each black dot. We know that at first it is one cell made up of two, which divides again into two, and these again into many, without separating. These cells turn into all the different parts of the tadpole, and will divide among them the work of its body.

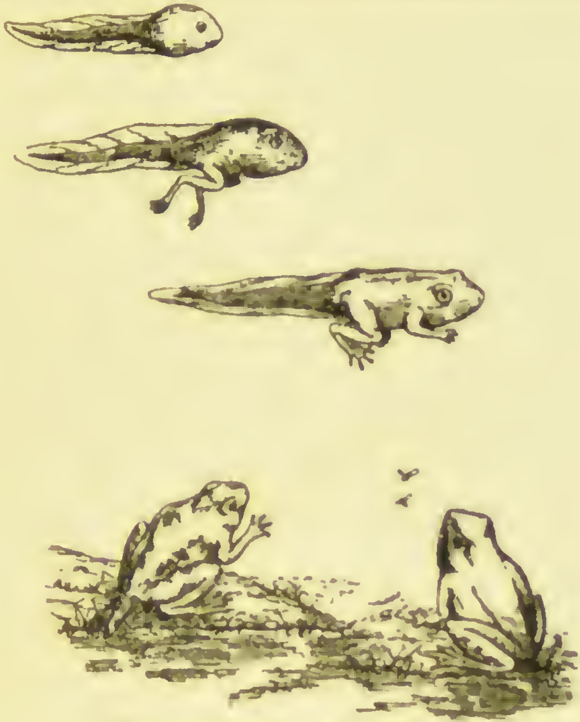


Tadpoles developing in spawn.

After a while we shall see the black dot becoming more the shape of a comma. The head of the comma is the tadpole's head, and the comma's tail is its tail. In the head part we may be able to distinguish eyes.

As the heads get bigger the tadpoles come out of their jelly envelopes (which by this time are thin and dirty looking), and swim about just like regular little fishes. They are at this stage also like fishes in the way they breathe air dissolved in the water, with gills at the sides of their necks, and so do not have to come to the surface to get free air. The mouth is not fully formed until the tadpoles are a little older.

Presently they grow hind legs, and shortly after out come a pair of front legs.



The development of the Frog.

About this time the heads and eyes and mouths begin to look more like those of frogs, and we see that the tails are growing shorter from the tips upwards till they quite disappear. The creatures are then perfect little frogs.

Before the tails shorten we ought to be careful to make fresh arrangements in our basin, or aquarium. We must build some kind of island on which the little things can sometimes creep out of the water. This is necessary because, as the tadpoles become frogs, they begin to breathe air through their nostrils, like land animals, and stop being fishes, so that if they had not some way of getting out of the water they would be suffocated. Frogs, you know, are what are called amphibians, who live both in water and on land. They can stay under water much longer than we can, but from time to time have to come up to breathe the air, or they would be smothered.

One may often see a frog sitting at the edge of a pond among the weeds with just his big eyes and his nostrils above water, enjoying the view and watching for insects. If disturbed he will pop down out of sight, but if we watch we shall soon see the big eyes appearing again at some other place.

The smallest tadpoles are said to be vegetarians, but certainly the larger ones fatten well on raw meat, which they eat greedily, while the grown frogs live upon insects. Their cousins, the toads, are very useful in gardens, eating up insects.

O all ye things that grow on the earth, bless
ye the Lord:
Praise and exalt Him above all for ever.
O ye fountains, bless ye the Lord:
Praise and exalt Him above all for ever.
O ye seas and rivers, bless ye the Lord:
Praise and exalt Him above all for ever.

O ye whales, and all that move in the waters,
bless ye the Lord:
Praise and exalt Him above all for ever.
O ye fowls of the air, bless ye the Lord:
Praise and exalt Him above all for ever.
O ye beasts and cattle, bless ye the Lord:
Praise and exalt Him above all for ever.
O ye children of men, bless ye the Lord:
Praise Him and exalt Him above all for ever.

* * * *

O all ye that worship the Lord, bless the
God of Gods, praise Him and give Him
thanks! For His mercy endureth for
ever.

From "The Song of the Three Holy Children."

Some Air Babies

CHAPTER VIII

SOME AIR BABIES

NOT long ago on a lovely April day I visited a beautiful old farmhouse in the country, where three little girls led me round to see their treasures, to each of which we paid a visit in turn.

They had gardens in which they had sown seeds, which were not yet showing above the pleasant brown earth; and they had a beautiful big dog who seemed, as he looked at you out of his loving brown eyes, to know a great deal more than anyone had told him.

In the farmyard were two large black mother hens, one of which was scratching and picking to turn up seeds and other food for her nine yellow downy little chickens, just out of the shells. Farther on the other was sitting with her wings half spread out, and from among the feathers peeped one or two little soft grey heads. We scattered fine grain, and seven more chicks came scrambling out to eat it, and pecked away till their mother called them back under her wings.

All these little chicks were so young and small and round that they seemed to be the very shape of the eggs they had come out of. It was quite easy to imagine just how they had been packed into them, before they broke their shells and found themselves in the fresh air and sunshine, with the shelter of their mother's wings to rest under and run to if anything frightened them, and with her to help them to find food.

From the farmyard we crossed a grassy bricked court, and came out into the garden. There in the ivy against a brick wall was a song-thrush's nest, where four blue eggs with brown spots were lying. Just at that moment neither mother nor father was sitting on them, and so we had a good look at them. I am sure the parents were anxiously watching us from some bush close by.

Near by against a barn wall, plain to be seen, amongst a lot of dry pea-sticks, I was shown a good-sized nest of grass and twigs, on which sat a beautiful blackbird, with yellow beak and long tail, and round black eyes watching us suspiciously. The bird could not have chosen a more visible place for the nest.

By the bright yellow beak and shining black feathers we knew that this was the father blackbird, who was taking his turn at keeping the eggs warm, while the mother had gone to get her supper and have a little exercise, of which I am sure she was much in need.

Out of a thorn and ivy bush, in a hedge farther on, a little linnet flew off as we came near, and we saw, when we peeped in, five beautiful little bluish-white eggs in a nest made of grass and lined with hair.

Against another wall I was shown a last year's robin's nest of moss, and high up in the barn a hole where last spring tree-creepers had their nest, and where it was much hoped they would come again this year, for birds very often nest in the same place year after year.

Some birds make one kind of nest and some another, and they choose special materials with which to build. Each kind also has its favourite situation. Some, as the house-martin, build high up under the eaves of houses, others lower down, and some, the lark and the plover, for instance, right down on the ground. Some sea-birds make theirs on the narrow ledges of cliffs, others among seaweed.

I have seen the nest of a little wren under the eaves of a cottage porch, another in a heather-thatched summer-house, and another in an old tree stump. They all were rounded, and built under something which formed a roof, with a little hole high up in the side just large enough for the tiny father and mother to pop in and out.

The father and mother birds take an immense amount of trouble over their children. First, they build the nest with great care, finding and choosing exactly what each kind considers the best materials to make it with. Then, when the eggs are laid, they sit upon them, taking turns carefully so that neither of them will be long enough away to allow the eggs to become too cool. If they did get cold the little birds inside them would stop growing and die.

When the nestlings come out of

the shells some kinds only are able to run about at once and peck for themselves. Most are little skinny things without feathers, who are too weak to stand, and who hold up big open mouths waiting to be fed, and ready to swallow whatever is put into them.

Then the good little fathers and mothers begin to work very hard, bringing food, and popping it, turn about, into each hungry gaping mouth. People who have carefully watched birds feeding their babies tell us that they are most particular to be quite fair and give each one its regular turn, so that none are overlooked or starved. To us it seems wonderful that they know which is which, because all to our eyes look so much alike.

Then when the little birds have grown enough feathers to be able to fly, the parents have them out, and teach them to do it nicely. They encourage the little ones to do more each time till they feel full confidence, and can get about quite well. I expect they also show them where to find the best food.

Though chickens and baby swans can stand at once on coming out of the eggs, I have heard that there are many things their mothers and fathers have to teach them. They give them first lessons in how to peck up their food, and I am told that the swans take a great deal of trouble to teach their children how to keep clean and arrange their feathers, so that when later they get their beautiful grown-up plumage they will be able to take proper care of it, and not allow it to get draggled or untidy.

Everyone who has read the "Story of the Ugly Duckling" by Hans Christian Andersen, knows that swan-children are not at first beautiful like their fathers and mothers.

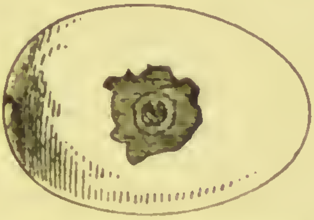
Though birds' eggs are of such different sizes and colours, and though some are rounder and others more pointed at the ends, yet the way the baby bird grows inside all is very much the same. If therefore we learn about one, we shall know much about the others.

The true egg is the yellow yolk with a small nucleus at one side. This nucleus it is which divides and again divides and grows into the bird. The yolk is what the little bird lives upon while it is in the shell. It also absorbs the white of the egg with which the yolk is covered. The white is contained in two tough membranes or skins, and outside all, before the mother bird lays her egg the hard shell is formed. This last keeps all safe and comfortable while the little bird grows. I ought also to say that somewhere in the egg, between the two membranes, there is always found a little space filled with air. The use for this you will see presently.

The eggs of each kind of bird take their special time to hatch, and if one is even a little longer than the right time there is danger that something has gone wrong with it, and that the little bird inside it is not alive.

II

If we really want to examine the inside of an egg it is best for us to ask, in the kitchen, for a fresh hen's egg which is just going to be broken and used. Then we can look at it first, and notice what is inside.



Egg seen from above with a portion of the shell and membrane removed.

If we hold it up to the light of a candle we shall see that it is quite clear all over. We do not see any part that is darker than another, because so little change has yet begun in it.

Let us then lay it down, and pick off the shell for about the space of a sixpenny piece at the highest part as the egg lies on the table. Then if, by the aid of a pair of scissors, we remove the tough membrane which we have uncovered, we shall see on the yolk a little round white spot. This is the part which has already begun to develop into a chicken. We may just see a little streak on it, which is the line where its back-bone will come.

If we roll the egg gently from side to side we shall notice that the little white spot always keeps at the highest part. It does so because the rest of the yolk is heavier than it is.

The whole yolk is suspended and balanced between two twisted ropes of white of egg which connect it with the ends of the shell. The heavier part naturally keeps below, and the lighter above as the egg is rolled round. You know these ropes or strings quite well. We often come upon them when we are eating an egg.

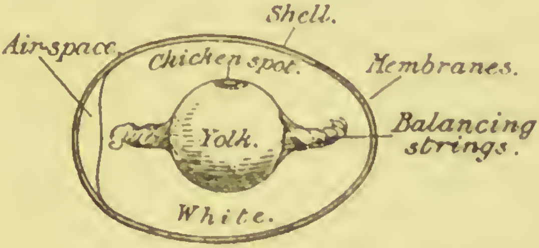


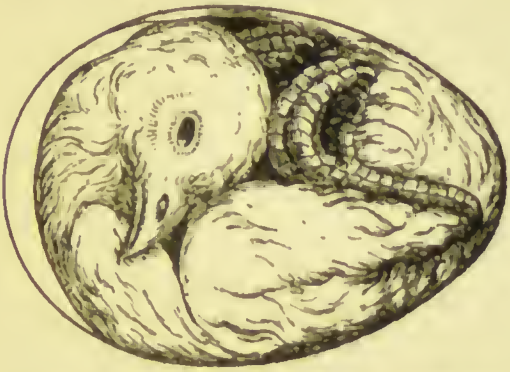
Diagram of Egg, seen sideways.

This balancing of the yolk has the great advantage that the chicken part keeps always top, and remains nearest to the warm body of the mother, and so gets all the heat she can give it.

If, instead of a quite newly laid egg, we had one upon which the hen had sat for a few days, we should, if we held it to the light, see blood vessels branching about in it, and if such an egg were still warm, and we opened it, we should find a spot, a little red spot which alternately became larger and smaller, redder and paler. This would be the developing heart of the chick which had already begun to beat, and will go on beating as long as the bird lives.

It is all most marvellous and beautiful !

On the twenty-first day the hen's chick is ready to come out of its shell which it now just fills. It has used up all the yolk, and its lungs are ready to breathe. It first breaks its way into the air chamber which we noticed in the egg, fills its lungs with air and then



Chick in Egg the day before it comes out.

cracks the shell. When the mother hen hears the chick moving and working inside the shell, she helps, too, with her stronger beak, and soon it struggles out, and sees all the interesting things around it.

With other birds it happens in

much the same way, but we have not generally as good an opportunity of watching them.

Though all the nest-building and hatching does not take many weeks the birds show much more care and love for their children than do the other animals we have spoken about. We have seen how the frogs just leave their eggs in the pond to take their chance. Many are eaten up by other animals at each stage of their growth, and those which survive have to learn, each for himself, how a frog must behave in order to get on well in the world where he finds himself. He gets no help from his parents, any more than do the seedlings of plants.

On this account ever so many more frogs' eggs have to be laid than are required to make enough grown-up frogs.

Birds, on the other hand, lay just a few eggs, which the parents hatch. After that they feed their children, defend them from their enemies, and teach them how to fight and otherwise look after themselves. They get more care than the frogs.

Thou hearest the nightingale begin the song
    of Spring ;
The lark sitting upon his earthy bed-nest,
    just as the morn
Appears, listens silent ; then springing from
    the waving cornfield, loud
He leads the Choir of Day.

William Blake.

Some Land Babies

CHAPTER IX

SOME LAND BABIES

OFTEN in the spring-time, when we walk in the country, we see new white woolly lambs playing round their mothers. Perhaps we came the same road the day before, and then saw the sheep feeding alone. Or it may be that the cow who yesterday was lying by herself in the paddock, contentedly chewing the cud, has with her to-day a little long-legged calf. Or we may hear that the cat has kittens, or the dog has pups. We run to find, in either case, a basketful of little helpless live creatures, who, with eyes not yet open, are unable to do anything for themselves except keep close to their mother (snug and warm in her nice fur), and suck the milk she gives them.

Now, none of these baby animals have grown in eggs which have been laid and hatched in earth like the seeds, or in water like those of fishes and tadpoles, or by the warmth of their parents' bodies, as are the little birds' eggs in nests.

Yet really every living thing comes from an egg, or at least from its most important part, the little round cell which has the power to divide and divide again, and so grow into a fresh creature.

It is only this one little cell which is of such great importance. The shell is only a protection, and the white and yolk are nothing but the nourishment upon which the baby bird lives till it is big enough to come out.

If this special little cell could be nourished some other way, and taken great care of till it had had time to grow complete enough to live separately, there would be no need for either shell or white, and almost no yolk would be required.

Now this is really what happens in the case of the higher animals.

This precious cell is not packed up in white of egg, nor supplied with a large yolk, nor covered with a shell membrane or hard shell, but it is taken care of in a way which is ever so much safer, in a place where nothing can touch it. It is, in truth, packed away inside the body of the mother, and there safely protected from every harm.

While still microscopically small the little cell becomes attached to a place inside the mother which is ready to receive it. There it takes root, in warmth and safety, and getting its nourishment from its mother's body, grows bigger and more perfect every day. Then when the full time has come (each kind of animal has its own peculiar time) and the young one is fit to breathe and feed, and live independently, a way opens by which it is brought forth, or as we say, it is born.

Even after that the mother feeds it with her own milk and takes the most loving care of it, teaching it everything it ought to know.

Little lambs and calves and colts are born able to stand and run about at once, like the chickens when they break open the shell. There are others, like the pups and kittens, which are even more helpless than the nestling birds just out of their shells. Puppies and kittens, indeed, do not open their eyes for some days after they are born.

Many animals have quite wonderful ways of looking after their babies. For instance, the kangaroo mothers (who live in Australia) have beautiful pockets in front in which they carry the little ones about.

Some kinds of opossum carry their little ones on their backs. The babies hold on by curling their little tails round their mother's big one.

All these different kinds of babies grow up so quickly that it is not long before they learn nearly everything they need to know, and go off into the world to seek their own fortunes and fight their own battles.

Little lamb, who made thee?
Dost thou know who made thee,
Gave thee life, and bade thee feed
By the stream and o'er the mead;
Gave thee clothing of delight,
Softest clothing, woolly, bright;
Gave thee such a tender voice,
Making all the vales rejoice?
Little lamb, who made thee?
Dost thou know who made thee?

Little lamb, I'll tell thee;
Little lamb, I'll tell thee:
He is callèd by thy name,
For He calls Himself a Lamb.
He is meek and He is mild,
He became a little child:
I a child, and thou a lamb:
We are callèd by His name:
Little lamb, God bless thee!
Little lamb, God bless thee!

William Blake.

Where Do We Come From?

CHAPTER X

WHERE DO WE COME FROM?

SOONER or later a time comes to each of us when we begin to wonder where we ourselves came from; or perhaps we want to know how a little baby brother or sister has come into our home. It seems very natural that we ourselves should be there, but his arrival puzzles us. Yesterday he had not come, and today he is quite an important person, in whom we are ever so much interested, and who is joyfully welcomed by all.

I almost think that anyone who has read and understood this book, so far, ought to be able to answer this question at least to a certain extent.

We all feel that we have much in common with our friends the animals, and with all the living creatures of which we have spoken. Though our lives are in many ways different from theirs, our bodies as well as theirs develop from little cells, and the human babies, when they come, only differ from the young animals in being even more helpless than most of them are.

We have noticed how the chickens can run about at once when they are out of the shell, and lambs frisk and play in the fields from the first. Even helpless puppies, in a few weeks become clever little dogs.

It is not in the way we come into

the world that we differ from these, but in the lives we are to live afterwards.

Birds and animals are very soon quite grown up. In a few months, at longest, most of them are ready to leave and forget their parents, who also forget them. The young ones by that time find their own food, and can follow all the occupations which are natural to them. What they have to learn in order to carry on their lives is, after all, very little, and it takes but a short time to acquire. The greater part of their knowledge seems to come to them as instinct, and has not, as far as we know, to be taught to them by others. They and their parents soon have no more interests in common.

The wonderful truth about our own actual birth is very like what I have told you about that of the little lambs.

As the seed in a flower is fertilised by the pollen from another flower and made able to grow into a fresh plant, so a cell, which is truly a part of the mother, is fertilised by the father, and so given the power to develop and grow into a human baby.

Just as the little lamb is kept safe and warm inside its mother till it is perfectly formed, so our own mothers carry us and protect us within themselves for nine long months, until we become big and strong enough to breathe and cry, and feed, and live as separate beings. The mother knows about it all the time, and thinks much about her little child. She loves it before she sees it, and gets ready everything it will require to clothe it and make it comfortable.

When the nine months are accomplished a way is opened for it, and the baby is born.

There is a great deal about all this which it is impossible for us to understand until we are quite grown up; it is all, however, such a beautiful and intimate thing that we do not speak about it except to our mothers themselves or to some other very dear friend, who is like a mother to us.

A little new-born baby is even more helpless than most of the young birds and animals, and needs much more to be done for it by its mother and father and all the other kind people around it.

At first its mother feeds it with her milk, and afterwards she gives it just the right kind of food upon which it will grow bigger and keep well and strong. It has to be washed and dressed and kept warm, and it will be years, instead of a few weeks, before it can do much for itself.

Human beings grow so slowly, compared with animals, and require care for such a long time, because they have before them much greater tasks, and look forward to more complicated lives than do the animals. They require more time to prepare and learn. We have seen that when young animals have found out where and how to get their food, and are strong enough to fight with their enemies, they know nearly everything which is necessary for them.

A child, on the other hand, while growing up into a man or woman, has to learn all kinds of different things. He has a mind which ought to go on growing as long as life lasts, and which must be fed upon knowledge, just as his body needs food regularly, or else it, too, will grow weak and ill. He has, also, a living soul, and must learn right from wrong, and be trained to play his part in the world among other people. All this father, mother, and friends help to teach him.

Thus, human families, with their higher interests and wider sympathies, do not separate and forget each other, but continue all their lives long to be bound together by ties of relationship and sympathy.

There are some things which children and young people who are growing up should be very clear about.

Everyone of us ought to remember that all which our father, mother, and friends are doing for us and being to us, we, when we are grown up, shall have to do for the next generation. For this reason, if for no other, we ought to do our best to keep clean, strong, healthy bodies and minds.

Just as our bodies are stronger and better for exercise, fresh air, cold tubs, and wholesome food, so our minds and characters are healthier and cleaner if we think good, happy thoughts about fresh and wholesome things. It has been very truly said that we grow like the thoughts which we allow ourselves to think, and you will find, if you try, how easy it is to put a bad idea out of the mind by thinking of something else. If we are tempted to do something which we know we ought not to do, we must not go on thinking about that thing, but at once *turn our thoughts* to some other subject which interests us, or go and *do* something else.

Let us remember the advice of St. Paul: "Whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report, if there be any virtue, and if there be any praise, think on these things." If we remember and act upon this, and make a habit of so doing, we shall always find it easier to do right, and we shall grow up more able to help others than if we let unkind and selfish thoughts get power over us.

Our fathers and mothers begin to make us, but all our lives long we go on making ourselves. Let us do it as well as possible.

O Lord, Thou hast searched me out and known me,
Thou knowest my downsitting and mine uprising, Thou understandest my thought afar off.

* * * *

For Thou hast possessed my reins :
Thou hast covered me in my mother's womb.
I will praise Thee ;
For I am fearfully and wonderfully made :
Marvellous are Thy works ;

And that my soul knoweth right well.
My substance was not hid from Thee when
I was made in secret,
And curiously wrought in the lowest parts
of the earth.
Thine eyes did see my substance, yet being
unperfect ;
And in Thy book all my members were
written.
Which in continuance were fashioned, when
as yet there was none of them.
How precious also are Thy thoughts unto
me, O God !
How great is the sum of them !
If I should count them,
They are more in number than the sand :
When I awake, I am still with Thee.

Psalm cxxxix. 1–2, 13–18.

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Printed by
Cassell & Company, Limited, La Belle Sauvage,
London, E.C.